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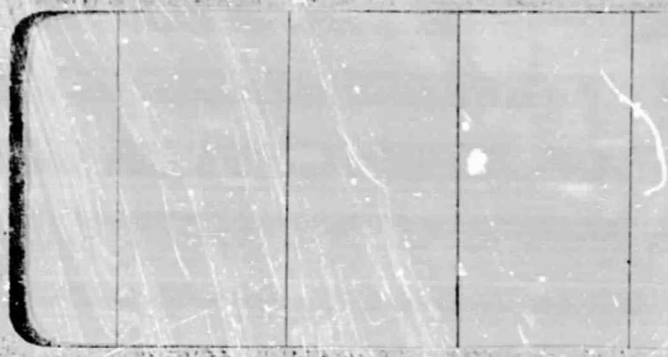

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Retransmission of Hydrometric Data in Canada

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14. Supplementary Notes

Report prepared by I.A. Reid, R.A. Halliday and R.O. Christie.
Much of the success of this project is due to the efforts of personnel in Water Survey of Canada Districts and in the Instrumentation Section, Glaciology Division.

15. Abstract

Data Collection Platforms have been installed at Water Survey of Canada gauging stations for transmission of hydrometric data including water level, water velocity, precipation, air temperature "ice-out" indicator, DCP battery check, and water stage recorder clock operation using the Landsat Data Collection System.

The system has met requirements and the suitability of satellite retransmission has been demonstrated. Several new Data Collection Platforms have been checked out for installation later in 1975.

PREFACE

The purpose of the investigation is to use ERTS Data Collection Platforms (DCPs) to transmit water level and other related readings from each of the nine remotely located platforms and to use the information for operational purposes.

The DCPs have been used to transmit water level data from sites in northern and western regions of Canada. Other data transmitted from some locations include precipitation, air temperature, water velocity, "ice-out" indication, DCP battery voltage, and water stage recorder operation check. Data were used both for water management purposes and for planning hydrometric field activities.

During the six months January to June 1975, about 10,000 transmissions were received. Some DCPs were turned off for part of the period. Experiments were conducted with DCP power supplies, an add-on memory was used with one DCP, and an integrating water velocity meter was re-installed. New Data Collection Platforms were received and some were checked out.

The program continues to demonstrate that water resources data can be retransmitted reliably and at reasonable cost by satellite.

TYPE II Progress Report for the
Period January-June 1975

The Water Survey of Canada operates over 2400 gauging stations at which water level data are collected. The data are used for many purposes including river flow and flood forecasting, and water level forecasting for navigation. In many cases, it would be desirable to obtain data on a near real time basis, however, because of the isolated locations of most gauging stations, the cost of doing this has been prohibitive.

Therefore, when the ERTS (now Landsat) Data Collection System was proposed, it seemed worthwhile to investigate the possibility of using a satellite retransmission system to collect water level readings from a few gauging stations, and to use the data for operational purposes. In this way, a valid assessment regarding reliability, costs and other aspects of the whole system could be studied and decisions made with respect to the feasibility and advantages of establishing a much larger network of DCPs dependent on future satellite facilities. The sites were selected to give a wide range in climatic and aerial conditions.

Nine General Electric Data Collection Platforms (DCPs) were installed in 1972, and, as results of the program were so successful, an additonal 19 DCPs were purchased from Ball Brothers Research Corporation (BBRC) for installation in 1975. The Ball DCPs are Landsat-GOES convertible units. An agreement between the Inland Waters Directorate, Canada Department of the Environment and the US National Environmental Satellite Service for use of the SMS-GOES system is now in effect. For the present, however, most of the Ball DCPs will be used in the Landsat mode.

A new data format has been implemented since receiving the new convertible platforms. To meet the requirements of NESS for the SMS-GOES system, an ASCII compatible format will be used for all parallel digital words. This will save changing interface cables in the field if platforms are converted from Landsat to GOES. The format requires that the most significant digit be on the left but within each digit, the least significant bit is on the left. All the BBRC platforms and the GE platforms except 6102 and 6232 will transmit in the new format.

FIGURE I

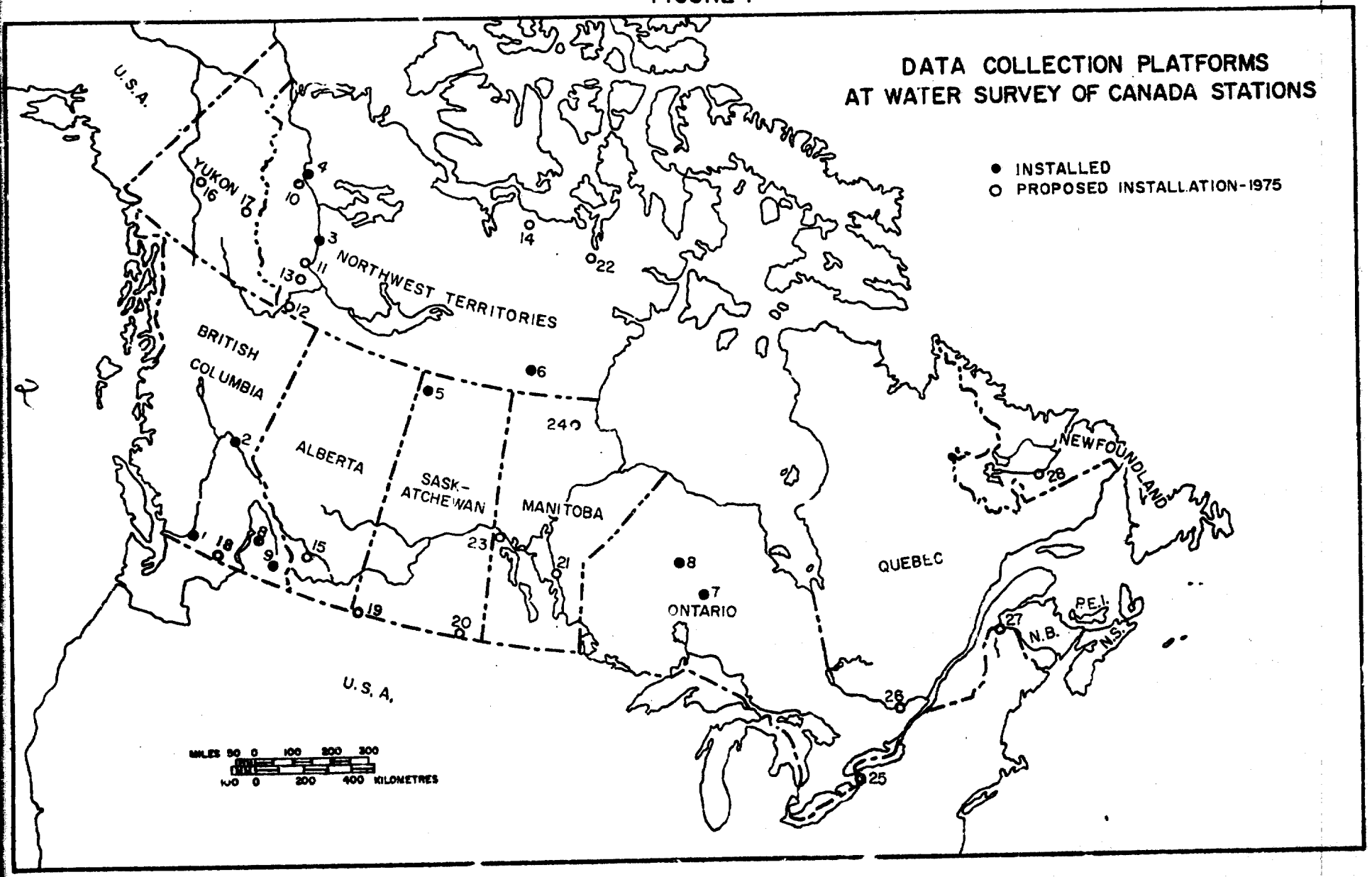
DATA COLLECTION PLATFORMS
AT WATER SURVEY OF CANADA STATIONS
● INSTALLED
○ PROPOSED INSTALLATION-1975
U.S.A.
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASK-ATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
P.E.I.
N.B.
N.S.
U.S.A.
MILES 50 0 100 200 300
100 0 200 400 KILOMETRES

TABLE 1

LOCATION OF DATA COLLECTION PLATFORMS

	INSTALLED	DCP	LAT.	LONG.
1)	Nahatlatch River Below Tachewana Creek	6232	49° 57'	121° 52'
2)	McGregor River at Lower Canyon	6354	54° 14'	121° 40'
3)	Mackenzie River near Wrigley	6260	63° 16'	123° 36'
4)	Mackenzie River at Sans Sault Rapids	6366	65° 46'	128° 45'
5)	Lake Athabasca at Crackingstone Point	6150	59° 23'	108° 53'
6)	Kazan River at Outlet of Ennadai Lake	6353	61° 15'	100° 58'
7)	Albany River above Nottick Island	6102	51° 38'	86° 24'
8)	Winisk River at Kanuchuan Rapids	6137	52° 58'	87° 42'
9)	Carney Creek below Pambrun Creek	6126	50° 10'	116° 35'
	PROPOSED - 1975			
10)	Mountain River below Cambrian Creek	6542	65° 14'	128° 34'
11)	Root River near the Mouth	6512	62° 29'	123° 26'
12)	Liard River at Fort Liard	6547	60° 15'	123° 29'
13)	South Nahinni River above Virginia Falls	6572	61° 38'	125° 48'
14)	Ellice River near the Mouth	6507	67° 42'	104° 08'
15)	Bow River below Carseland Dam	6527	50° 50'	113° 25'
16)	Pelly River at Pelly Crossing		62° 50'	136° 35'
17)	South MacMillan River at Mile 249 Canal Road		62° 55'	130° 32'
18)	Mission Creek near Kelowna		49° 54'	119° 08'
19)	Battle Creek at International Boundary		49° 00'	109° 25'
20)	Long Creek at Western Crossing of International Boundary		49° 01'	103° 04'
21)	Lake Winnipeg at Berens River		52° 21'	97° 00'
22)	Back River below Deep Rose Lake		66° 05'	96° 30'
23)	Moose River near Moose Lake		53° 38'	100° 19'
24)	Seal River below Great Island		58° 54'	96° 17'
25)	Niagara River at Fort Erie Customs Dock		42° 56'	78° 55'
26)	Rideau River at Ottawa	6517	45° 23'	75° 42'
27)	St. Francis River at Outlet of Glasier Lake	6502	47° 12'	68° 57'
28)	Churchill River at Muskrat Falls	6504	53° 15'	60° 47'

Figure 1 shows the locations of the nine original DCPs and the sites at which DCP installations are proposed for 1975. Table 1 is a listing of the sites by name and geographic co-ordinates.

During the reporting period two experiments concerning DCP power supplies were conducted. The first of these was use of Cipel & Le Carbone Type 321 J air-depolarized primary cells. The main purpose of the experiment was to verify the projected five year life of the cells and to check cold temperature performance. A battery composed of 18 cells was installed as the power supply for DCP 6137 in September 1974. In the winter of 1974-75, the daily mean temperature at Lansdowne House, a settlement about 80 km from the DCP site, ranged from -10 to -30°C and it was found that transmissions seldom occurred when the daily mean temperature dropped below -20°C. As the temperature moderated in the spring the DCP resumed its normal transmission rate. This can be seen in Table 2 which is a tabulation of transmissions from all platforms. From this experiment it was concluded that the air-depolarized cells would not be a satisfactory DCP power source at sites where cold temperatures occur. It should be noted that the manufacturer warned that the cells would not be able to supply a 3.3 A peak current draw at -40°C.

The second experiment concerned the use of a 3.5 W solar panel as a charging unit for lead acid or alkaline rechargeable batteries. The panel is Solarex Corporation Model 435 unit having regulation to a cut-off point of 14.7 V. The unit is installed at a test site on the Bow River below Carseland Dam (site 15, Figure 1) and is mounted 3 m above ground level, facing due south with an elevation angle of 45° (Figure 2). Maximum daily output has been in the order of 4500 C with 1500 C being produced even in poor weather conditions. Further testing of the unit is required, however it appears to meet manufacturer's specifications and will be capable of maintaining the charge on DCP batteries.

A BBRC add-on memory module has been connected to DCP 6210 which is operated by another Principal Investigator. Every 15 minutes a water level reading is entered into a shift register consisting of twelve, 60 bit memory sets. The memory sets are transmitted sequentially every 90 seconds. The number of messages received is sufficient to reconstruct the water level hydrograph on the basis of one reading every 15 minutes. A sample retrieval is shown in Figure 3. (Water levels are in metres.)

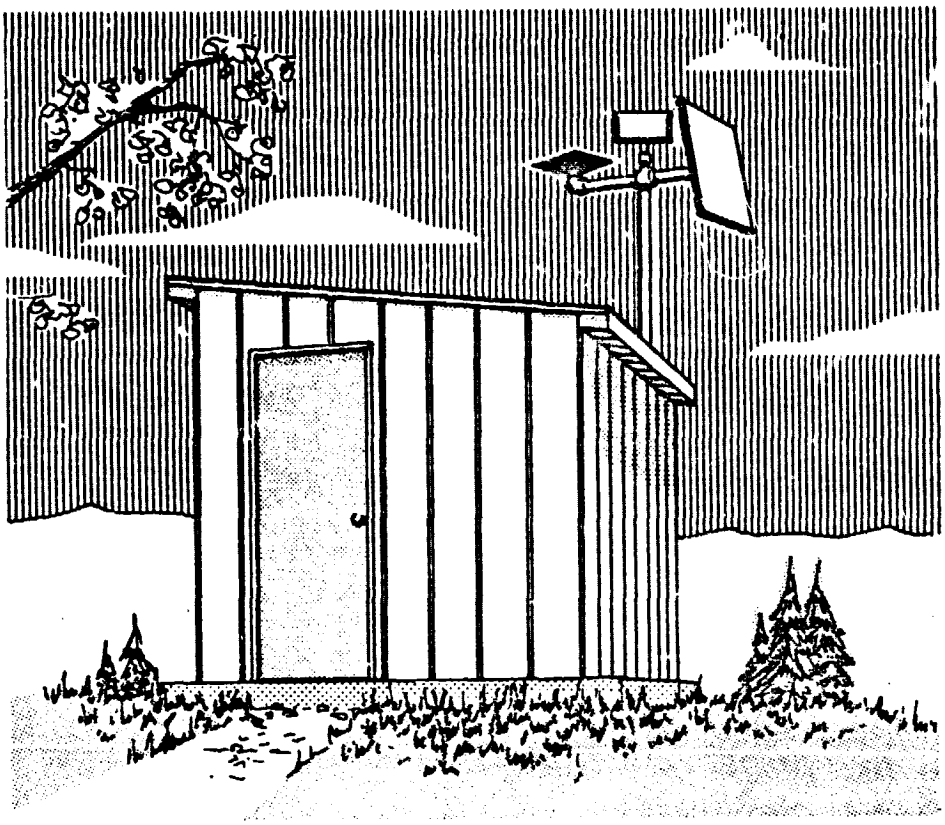

Figure 2 - Bow River Test Site

In June 1975, a two-channel electromagnetic water current meter (Marsh-McBirney Model 711) complete with an integrating accumulator designed by Glaciology Division instrumentation personnel was re-installed on the Nahatlatch River below Tachewana Creek (site 1, Figure 1). The integrating accumulator enables computation of the average river velocity at a point in the cross-section between orbital passes of Landsat 2. These average velocities are used to study water level-discharge interactions.

The analogue voltage X and Y components of velocity are generated by the current meter and are fed into the two channels of the integrating accumulator which performs independent voltage to frequency conversions. The resultant frequencies continuously clock their associated accumulating counter registers. The appropriate eight bits of the two X and Y registers are connected to two parallel digital channels of the DCP. The length of the registers (position of MSB) are chosen so as not to overflow between orbital passes with the maximum expected input voltage (velocity).

TABLE 2

SUMMARY OF RETRANSMITTED DATA - DEC 25, 1974 TO JUNE 22, 1975

Daily Mean Transmissions per cycle for cycles 50 to 59 (Transmissions received simultaneously at both Goddard and Goldstone are counted only once.)

Platform ID	50	51	52	53	54	55	56	57	58	59	Daily Max	Daily Min*	Total
6102	15	8	7	7	6	8	8	8	7	6	15	2	1343
6126	-	-	-	-	4	6	5	5	4	4	8	1	427
6137	3	1	1	6	6	6	11	14	13	11	17	1	1223
6150	13	12	14	14	13	13	13	14	14	11	18	5	2258
6232	7	6	7	6	7	7	7	7	7	5	10	2	1105
6260	-	-	-	-	-	-	-	-	-	-	-	-	-
6353	14	12	14	14	13	14	15	15	14	12	19	4	2353
6354	7	6	7	8	7	8	7	8	8	6	11	3	1255
6366	-	-	-	-	-	-	-	-	-	5	9	2	48
													10015

* The minimum transmissions do not necessarily reflect the true minimum as the DCP could be turned off for part of the day the minimum value occurred.

FIGURE 3

LANDSAT DATA COLLECTION PLATFORM SYSTEM
DATA FORMATTING & RETRANSMISSION FROM CCRS OTTAWA,CANADA

** TELEX OPERATORS PLEASE TYPE (FIGURES) (F) AFTER (WRU)
UNTIL A PERIOD (.) IS RECEIVED FROM COMPUTER

S	Y	DDDHHMM	SS	PID	C	D1	D2	D3	D4	D5	D6	D7	D8	CS
UPDATE: 4,43, 13,6.1975,														
N	5	2241320	07	6210	7	3	2.616	2.616	2.616	2.616			7	
N	5	2241321	36	6210	7	10	2.618	2.618	2.618	2.618			7*	
N	5	2241323	06	6210	7	5	2.618	2.618	2.618	2.618			1	
N	5	2241459	51	6210	7	A	2.62E	0.620	2.620	2.620			4*	
N	5	2241501	20	6210	7	B	2.620	2.620	2.620	2.620			6	
N	5	2241502	49	6210	7	0	2.614	2.612	2.614	2.614			2	
N	5	2241504	18	6210	7	1	2.614	2.614	2.614	2.614			3	
N	5	2241505	47	6210	7	2	2.616	2.616	2.614	2.614			0	
N	5	2241507	16	6210	7	3	2.616	2.616	2.616	2.616			7	
N	5	2241508	45	6210	7	4	2.616	2.616	2.616	2.616			2	
N	5	2241510	14	6210	7	5	2.618	2.616	2.616	2.616			7	
[illegible]	5	2231637	43	6210	7	0	2.624	2.624	2.622	2.624			7	
[illegible]	5	2231638	12	6210	7	1	2.626	2.626	2.624	2.624			5	
[illegible]	5	2231642	09	6210	7	3	2.626	2.626	2.624	2.624			1	
[illegible]	5	2231642	09	6210	7	3	2.626	2.626	2.624	2.624			1	
[illegible]	5	2231643	38	6210	7	4	2.626	2.626	2.624	2.624			4	
[illegible]	5	2231643	38	6210	7	4	2.626	2.626	2.624	2.624			4	
[illegible]	5	2231645	07	6210	7	5	2.626	2.626	2.624	2.626			5	
N	5	2241644	41	6210	7	9	2.618	2.618	2.618	2.618			2	
N	5	2241646	07	6210	7	A	2.620	2.620	2.620	2.618			1	
N	5	2241646	09	6210	7	A	2.620	2.620	2.620	2.618			1	
N	5	2241647	37	6210	7	B	2.620	2.620	2.620	2.620			6	
N	5	2241647	37	6210	7	B	2.620	2.620	2.620	2.620			6	
N	5	2241650	33	6210	7	1	2.614	2.614	2.614	2.614			3	
N	5	2250056	58	6210	7	1	2.612	2.612	2.614	2.612			2	
N	5	2250058	24	6210	7	2	2.610	2.612	2.612	2.612			7	
N	5	2250059	51	6210	7	3	2.610	2.610	2.612	2.612			2	
N	5	2250101	17	6210	7	4	2.610	2.610	2.612	2.610			6	
N	5	2250102	43	6210	7	5	2.612	2.612	2.612	2.612			2	
N	5	2250104	10	6210	7	6	2.612	2.612	2.612	2.612			4	
N	5	2250237	53	6210	7	B	2.614	2.614	2.614	2.614			1	
N	5	2250239	20	6210	7	0	2.612	2.612	2.612	2.612			7	
N	5	2250240	47	6210	7	1	2.612	2.612	2.612	2.612			1	
N	5	2250242	13	6210	7	2	2.616	2.612	2.612	2.612			3*	
N	5	2250243	40	6210	7	3	2.612	2.612	2.614	2.612			6	
N	5	2250245	07	6210	7	4	2.612	2.610	2.612	2.612			1	
N	5	2250246	34	6210	7	5	2.610	2.610	2.610	2.612			1	

END OF DATA
Job 13, User [110,133] Logged off TTY3 1310 19-Aug-75
Saved all files (3 blocks)
Runtime 6.13 Sec

Thus knowing the elapsed time between orbital transmissions and the associated differences, the average velocity can be ascertained.

Some of the new BBRC DCPs were checked out during the reporting period but none were permanently installed. Progress has been slowed by the fact that the manufacturer did not supply mating connectors for the units and that the part numbers shown for the connectors in the manual were not correct.

The problem with the Telex output of retransmitted data from the Canada Centre for Remote Sensing was found to be in the interface supplied by the telephone company and has been corrected. Canadian users of the retransmitted data can now retrieve the information by either Teletype or Telex.

Personnel from the Canada Centre for Remote Sensing have conducted a study of the cost of demodulating the retransmitted data from Landsat and GOES at their existing Prince Albert, Saskatchewan Satellite Station. The cost figures are reasonable but funding from the Department of the Environment is necessary before implementing the system.

The Landsat Data Collection System has continued to provide useful near real time data for water management purposes in Canada. The data loss that occurred around the time of the Landsat 2 launch on January 22, 1975 did not seriously hinder operations as the probability of a major hydrologic event in January in Canada is low.

Plans for the near future are to continue existing programs and to install the new BBRC DCPs.